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Mieczysław Szyszkowicz*

Population Studies Division, Health Canada, Ottawa, ON, 101 Tunney's Pasture, K1A 0K9, Canada

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***Corresponding author:** Mieczysław Szyszkowicz, Population Studies Division, Health Canada, Ottawa, ON, 101 Tunney's Pasture, K1A 0K9, Canada, Tel: + (613) 762-1830; E-Mail: mietek.szyszkowicz@hc-sc.gc.ca

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Short Communication

Ambient Temperature and the Air Quality Health Index

Short Communication

The Air Quality Health Index (AQHI) [1] was introduced in Canada to represent a summary measure of ambient air pollution and air health effects. The AQHI is primarily applied to inform the Canadian public of health risks associated with ambient air pollution. It is used as a scaled indicator of the environmental health risk.

The AQHI is calculated hourly based on a formula that uses the rolling three-hour average concentration levels of three air pollutants. These are the gases: ozone (O3) at ground level, nitrogen dioxide (NO2), and particulate matter (PM2.5 - particles of air pollutants with a diameter of 2.5 micrometers or less). The formula used to calculate the index is as follows:

$$AQHI=(100*10/10.4)*(exp(0.000537*[O_3])+exp(0.000487*[PM2.5]) + exp(0.000871*[NO_2]) - 3)$$

The AQHI value is defined based on the relative risk of mortality associated with these three air pollutants. The coefficients in the above formula were estimated using the relation between acute increases in air pollution and associations with increased risk of death as determined using data from major cities across Canada [1].

Various combinations of air pollutants were realized to determine such indices[2]. In China, the index is based on PM10 (particles of air pollutants with a diameter not greater than 10 micrometers) and NO2 [3,4]; the Russian index incorporates formaldehyde, carbon monoxide (CO) and total suspended particles (TSP) [5]. Air pollutants such as PM10, sulphur dioxide (SO2) and NO2 are used in the European regional index [6].

The values of the AQHI are reported hourly on a scale of 1 – 10+. The AQHI provides air quality and health risk information using only a single number. Its values on web pages are often represented by colours ranging from light blue (1, no risk) to dark brown (10+, very high risk). The values can be used to implement health protective behaviours (reduce and/or change and/or reschedule outdoor activity) and decrease exposure to ambient air pollution.

In this study the AQHI values were determined independently of those officially communicated. Using the above formula and hourly measurements of three ambient air pollutants, the values of the index were calculated. Thus, for each day, we have 24 index values. The daily level can be represented by the daily average, maximum or other statistical value based on the 24 hourly indices. In this work we used the daily maximum to represent the value of the index. The main goal of this work is to investigate the relations between the index and ambient air temperature in two locations in Canada.

We used the data from two cities in Canada: Windsor (Ontario) and Edmonton (Alberta). Edmonton data are for the period from April 17, 1998 to March 31, 2002. Windsor data are for the period from April 1, 2004 to December 31, 2011. Table 1 summarizes the estimated values in both cities.

As we see from the table, the statistical characteristics of the AQHI are very comparable for both cities. We only observe large difference for temperature. For a simple analysis and comparison, we simply created a scatter plot to illustrate the relations between temperature and the AQHI values. To stabilize the variations and to simplify the plot, the temperature was grouped in bins of 5° C width.

Table 1: The statistics of the used variables.

Location	Variable	mean	sd	median	Q1	Q3
Windsor	aAQHI	3.8	1.1	3.6	3.0	4.4
	xAQHI	4.0	1.1	3.9	3.2	4.7
	aT	10.1	10.1	10.8	1.7	19.0
Edmonton	aAQHI	3.3	0.9	3.3	2.7	3.8
	xAQHI	4.3	1.3	4.2	3.4	5.0
	aT	4.6	11.4	5.9	-3.1	14.1

Note: a – average of daily 24 values, x – maximum daily value among 24 values, sd – standard deviation, Q1, Q3 – 25th and 75th percentile, T – daily temperature (°C). Windsor: N=2,466, Edmonton: N=1,445.

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Both figures indicate that the AQHI has a tendency to increase with temperature. It suggests that around 15° C and higher the index increases its value. This increase can be related to levels of ground ozone. As the AQHI is based only on three air pollutants, it also reflects seasonal changes in their levels [7,8].

There are a few publications which used the AQHI as an exposure/risk measure in relation to various health outcomes [9-15]. We conclude that the estimated higher values on hot days might also have preventive effects on temperature health impacts.

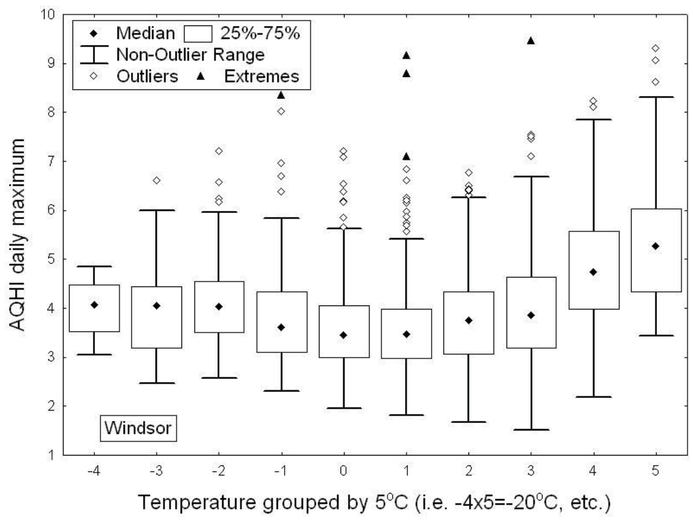

Figure 1: Temperature and the AQHI values (maximum). Windsor: April 1, 2004 to December 31, 2011.

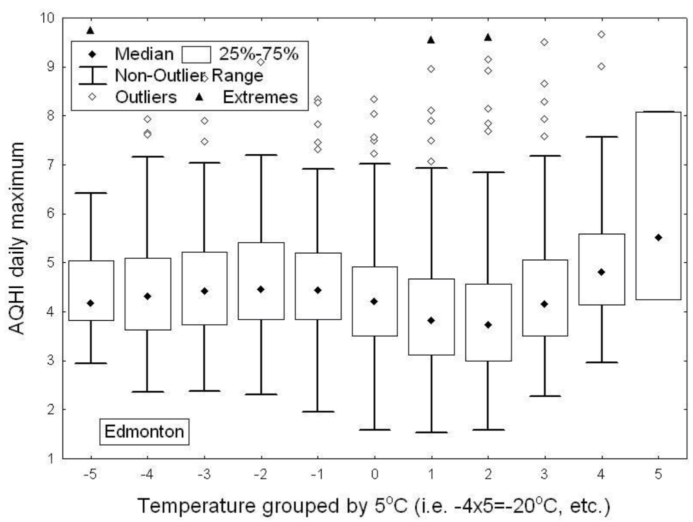

Figure 2: Temperature and the AQHI values (maximum). Edmonton: April 17, 1998 to March 31, 2002.

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